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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

The Heavy-Duty
Automotive Vehicle
Assembly Line

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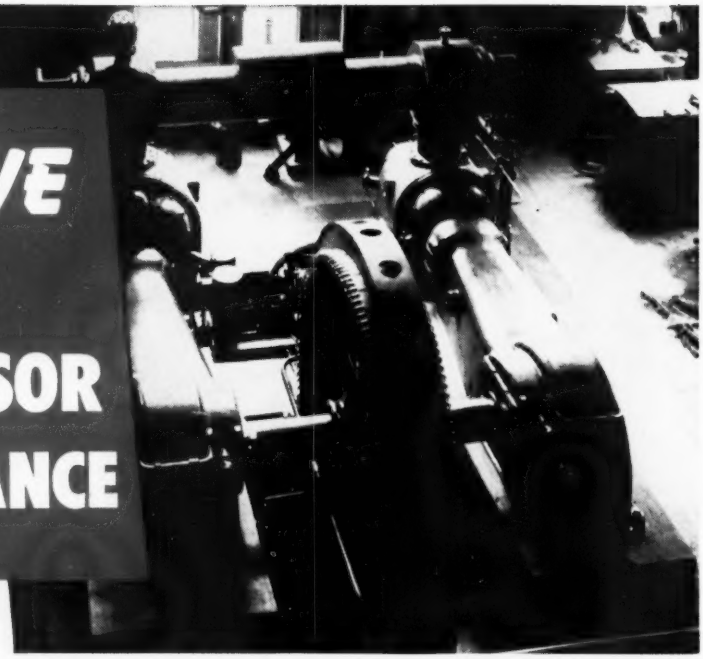

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FOR ALL OPERATING CONDITIONS

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by
The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Vol. XXXVII August, 1951 No. 8

Change of Address: In reporting change of address kindly give both old and new addresses.

The Heavy-Duty Automotive Vehicle Assembly Line

THE TYPE of machinery used in line production of heavy-duty vehicles is of particular interest to the lubrication engineer. It is the last word in synchronized operation. All parts must function in a coordinated manner, otherwise slowdown may develop. Faulty lubrication can cause malfunctioning, to thereby result in this slowdown. But more important, failure of any part due to continued faulty lubrication can cause production stoppage.

Mass production in the automotive industry became a reality when the designing engineers perfected machinery to run in sequence, which would handle and convey a vehicle under assembly in a straight line direction on one level. Starting with the frame, the finished vehicle today runs off the end of the "line" under its own power. The fact that it only takes from 12 to 15 minutes to assemble an entire truck, from the time the frame is first located on the floor conveyor until the finished vehicle is ready for road test, is evidence of the coordination which prevails among the various departments in the modern heavy-duty vehicle assembly plant.

The assembly line is clearly linked to national security and defense. Because of the importance of timely military production, obviously proper operation of the assembly line can affect military strategy perhaps thousands of miles away. Speedy replacements must be available immediately if tactical advantages are to be maintained.

Lubrication of the assembly line machinery plays an important part in this program. Synchronized operation must be maintained. It fails if any considerable number of gear sets or bearings are out of service due to faulty lubrication.

COORDINATION

An assembly line is a complex coordination of machinery of relatively simple design. Frames, motors, cabs, and body parts must be brought together at just the right time if maximum output is to be obtained. Where vehicles of one design and color are involved, (such as military trucks) coordination of conveyor operation is easier than when commercial trucks are being produced with several types of frames, colors, and engines involved. For example, a red cab must meet a red chassis at the proper assembly point at the exact time.

THE MACHINERY REQUIRED

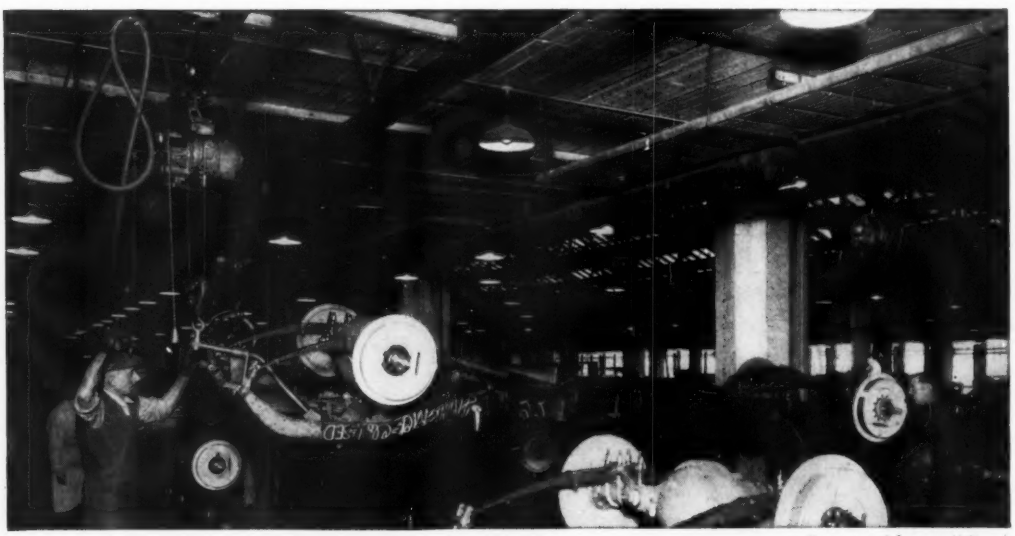
Electric motors drive the conveying machinery and speed reducing units which are required to move the vehicle frame from its start on the "line" till it rolls off under its own power — a finished vehicle.

Air power operates the overhead hoists and pneumatic tools required for handling and fitting together of the parts.

These basic machines along with the conveyor chain itself, the gears which reduce the speed from

Courtesy of International Harvester Company

Figure 1 — Frame turn-over hoist in operation after front and rear axle assembly has been made.



Courtesy of Ingersoll-Rand

Figure 2 — Ingersoll-Rand air hoists holding a chassis during turn-over after axles and springs have been installed.

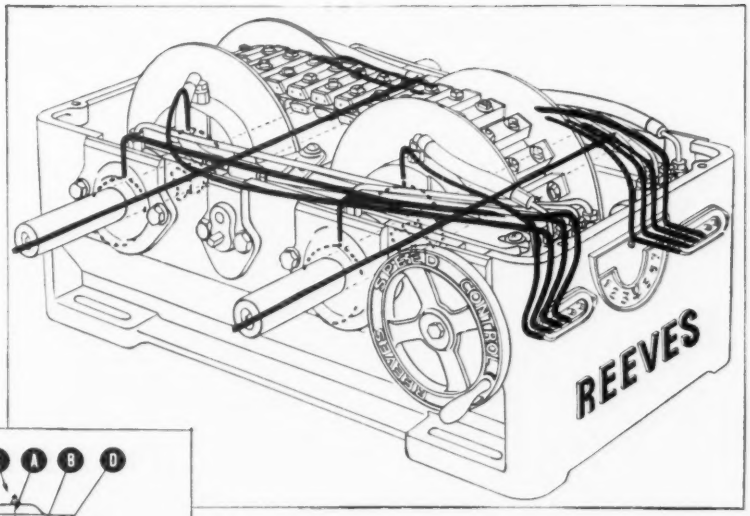


Figure 3 — Showing lubrication system of the Reeves enclosed design variable speed transmission.

Courtesy of Reeves Pulley Company

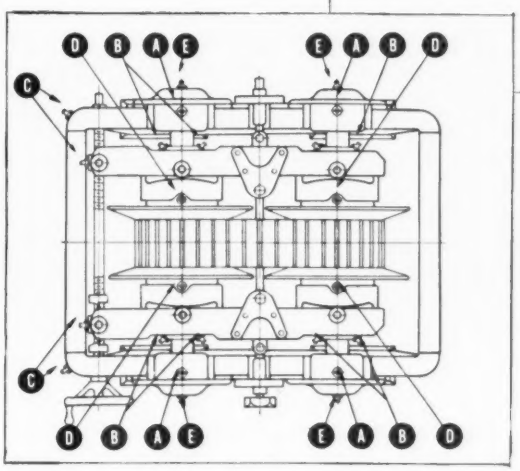


Figure 4 — The Reeves open design indicating features of the lubricating system and the force-feed lubrication fittings at points "A", "B", "C", "D" and "E".

Courtesy of Reeves Pulley Company

the power transmission unit and the lift trucks which dart around the plant under their own power, constitute the machinery on the assembly line. Each supplements a function of the other.

THE "LINE" ARRANGEMENT

The assembly line starts with the steel frame of the vehicle. This is brought to the floor-level bar-type conveyor where it rides temporarily, upside-down on a dolly. By locating the frame in this position all the under-frame parts such as axles, springs, brake rigging and miscellaneous piping can be set in place and bolted fast by the operators using pneumatic wrenches. By the time this is completed the frame has progressed to the turning location, where grapples are attached. Manipulated by overhead hoists which can be moved horizontally on rails, the frame then is turned right-side up and moved to another floor-level bar-type conveyor on which it rides during installation of the fixtures and piping.

Painting

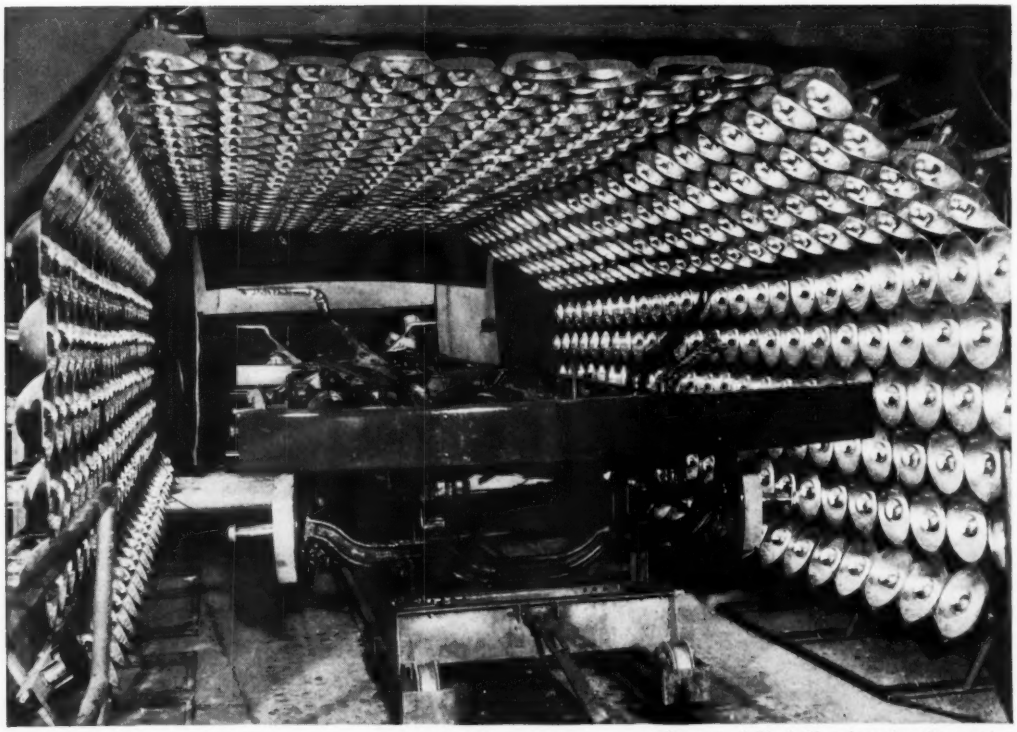
The assembly is then ready for painting. The first step here is to wash thoroughly with phosphoric acid or some other grease removing solvent. Then the threads of the wheel bolts are capped to keep them free of paint and avoid the necessity for cleaning later.

Painting is done by spray gun, with each unit receiving the special color designated by the production schedule. When the chassis later meets its cab and body parts such as fenders, obviously all colors must blend as planned. These parts incidentally are painted elsewhere in the average plant.

During passage through the paint compartment some paint naturally will get on to the floor conveyor chain links. If this is allowed to build up the accumulation may interfere with grease penetrating to the contact surfaces, although, as the conveyor runs so slowly and bends only in passing over the drive sprocket teeth at the driving end of the line, there is little chance for excessive wear if a good coating of grease is maintained.

Motor Installation

The chassis paint is dry as it leaves the paint drying compartment. Then the motor is installed, although in some plants the motor is installed before painting. Here design must be closely tied in with production because the motor must fit perfectly on its mountings, otherwise time loss might result in locating it. This means the type of chassis



Courtesy of Mack Manufacturing Corporation

Figure 5 — Truck frame assembly showing fitted axles and springs passing through the drying chamber after painting.

Courtesy of The White Motor Company

Figure 6 — Spray painting a truck body.

Courtesy of International Conveyor & Washer Corporation

Figure 7 — Starting point of a heavy duty travelling platform conveyor. The chain and flange wheels on this unit must be carefully lubricated to carry the prevailing loads.

must meet the type of motor it is designed for at just the right time. Considering that there may be several types of each and that several colors are usually being handled, the responsibility of the production planning people is obvious.

The Cab and Fenders, etc.

These parts, along with the tires, are installed after the motor and radiator are attached. They are brought to the main assembly by overhead conveyors and set into place by overhead hoists manipulated from the assembly floor.

CONVEYORS

Traveling conveyors of the roller or bar type are very widely used. The floor type propel the frames along the assembly line as the trucks are built up from the frame. The overhead type carry fenders, cabs, motors, hoods, and radiators from storage to paint shop and from there to the assembly line. These same overhead conveyors also can be used "merry-go-round" fashion for temporary storage of fenders or other body parts when necessary, in case there is any hold-up of the assembly line. The main conveyor chain may be adjusted to various floor levels to facilitate installation of certain parts, permitting the mechanics to work comfortably without too much stooping.

Lubrication of conveyor links is maintained by coating with grease. A good covering will effectually prevent penetration of shop dirt or paint as the conveyor carries the vehicle chassis through the paint compartment.

The Conveyor Drive

Floor level conveyors are driven by variable speed transmission units and a spur gear train, in order to obtain the very slow rate of travel of the

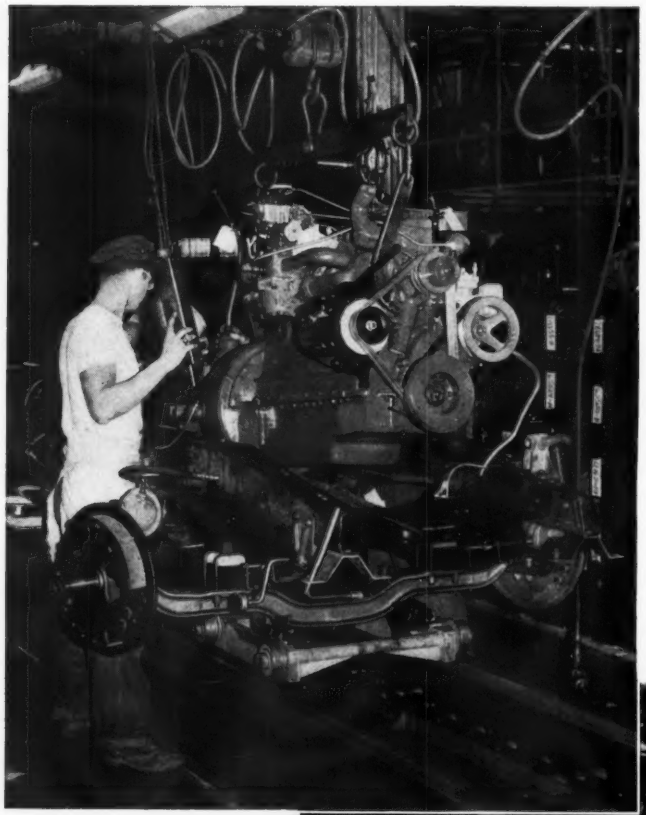


Figure 8 — Engine mount on a box-type conveyor, featuring the "industrial rail" and dollies for support of the front and rear axle assemblies.

Courtesy of International Harvester Company

Figure 9 — Working on the cab and fender assembly.

Courtesy of Mack Manufacturing Corporation

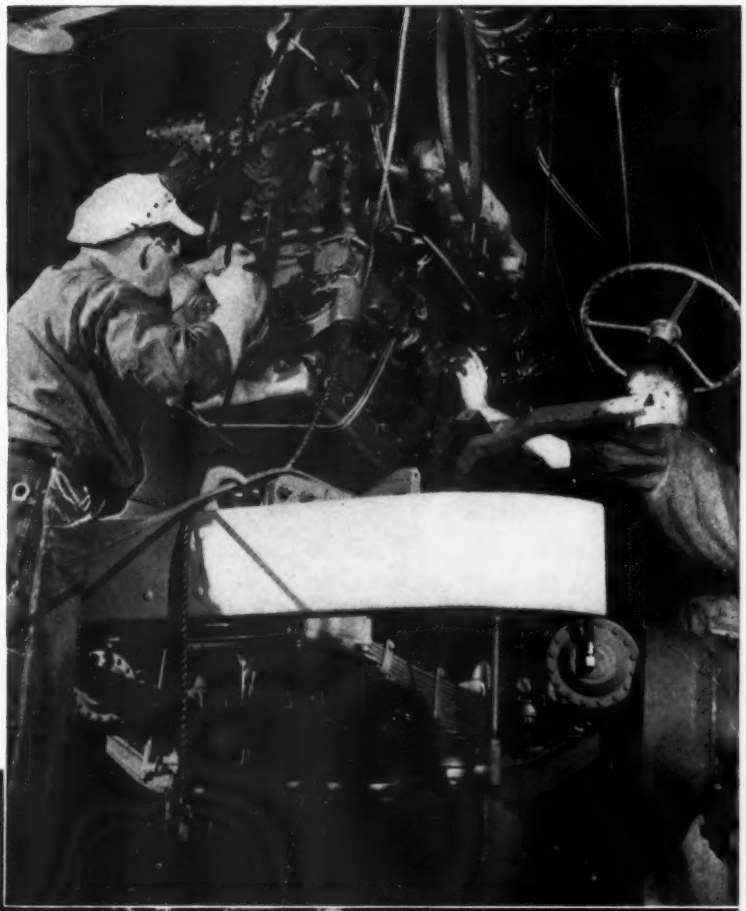
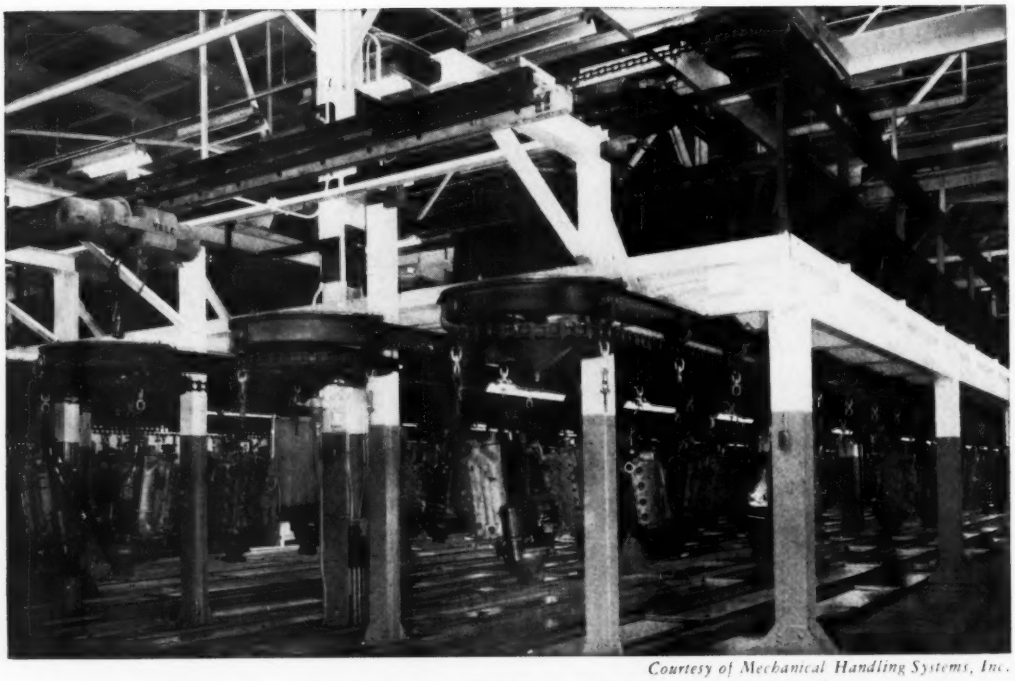


Figure 10 — Lowering an engine into place. Here accurate manipulation of the overhead hoists plays an important part.

Courtesy of Mack Manufacturing Corporation

Figure 11 — Working on the front end assembly as the truck progresses along the assembly line by "conveyor power."

Courtesy of Mack Manufacturing Corporation

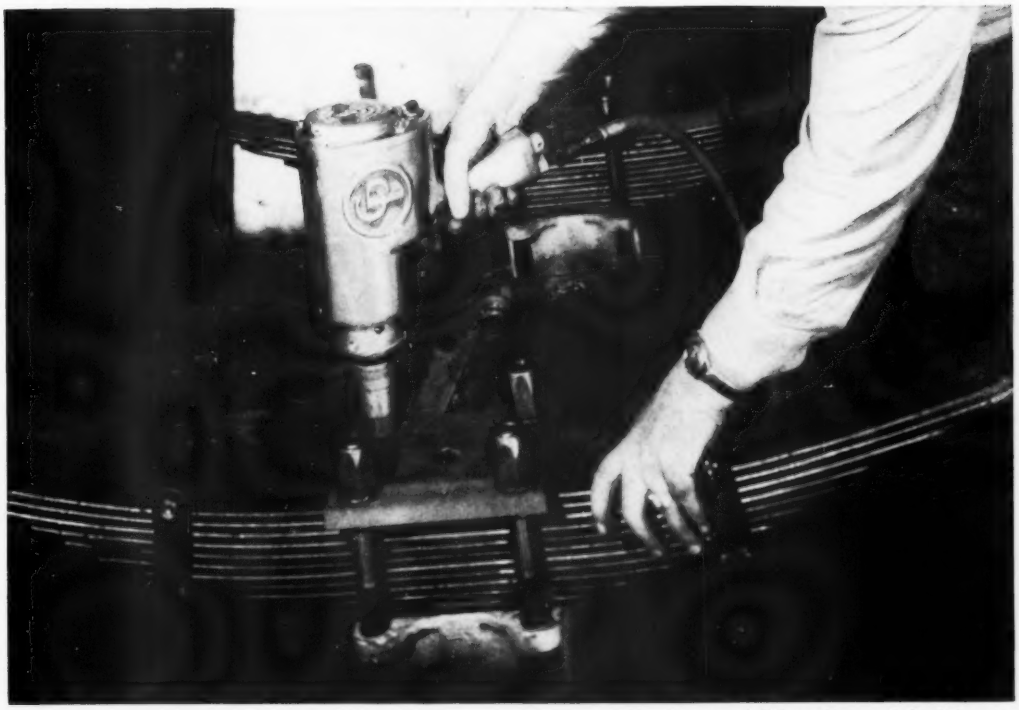


Courtesy of Mechanical Handling Systems, Inc.

Figure 12 — Handling motors from receiving through storage to the assembly line.

Courtesy of Lincoln Engineering Company

Figure 13 — A Mechanical Handling Systems conveyor equipped with Lincoln manifolds "A" for automatic lubrication of the power unit bearings.



Courtesy of Chicago Pneumatic Tool Company

Figure 14 — Using the air-powered impact wrench on a truck spring assembly. Proper tightening of U-bolts and reverse U-bolts is very important in eliminating spring breakage.

conveyor. Speed reducers are well housed and their bearings are protected against dirt-contamination of the lubricant. Spur gearing in these mechanisms, however, may be too large to house economically so they may be run exposed, and covered only by a cage for safety of plant personnel.

Lubrication of Motors and Variable Speed Transmissions

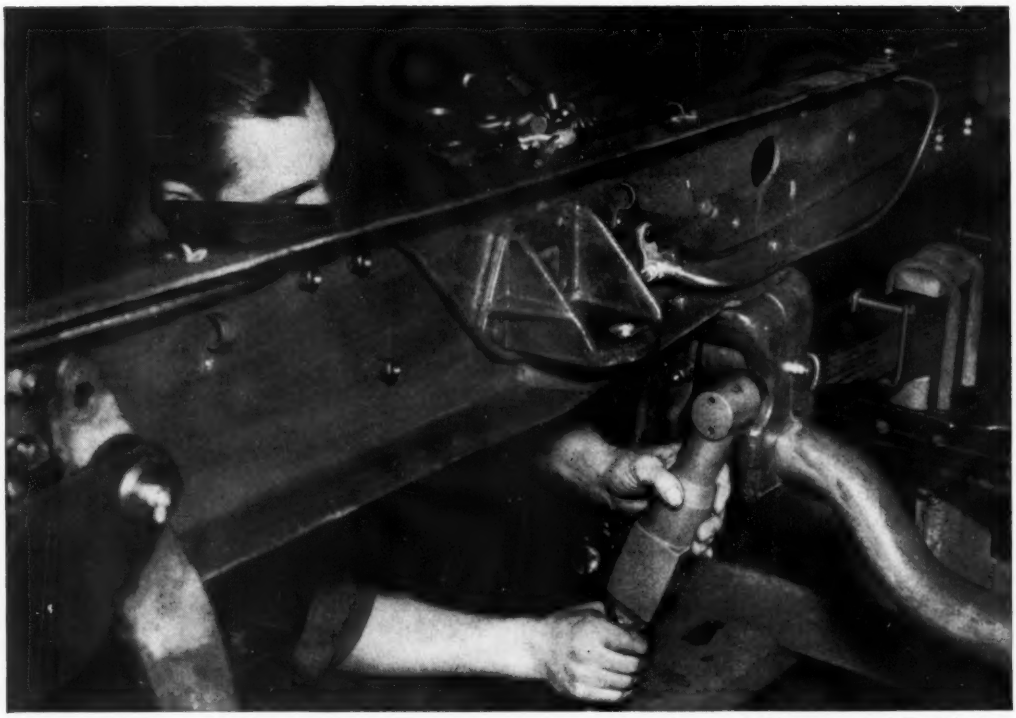
These units are discussed together as to lubrication since both very often are equipped with ball bearings. Pressure grease lubrication prevails and the construction normally includes well designed seals to prevent entry of abrasive dirt and leakage of lubricant.

Lubrication Procedure

In view of prevailing practice of using pressure gun lubrication, suitable fittings must be installed on the bearings for attachment of the gun when re-lubrication is necessary. This method of pressure lubrication is accepted as being highly efficient in protecting bearings capable of retaining a grease charge without leakage. The gun must be carefully handled, however, otherwise too much grease can be forced into the bearing housing. This may readily lead to overheating, especially if the grease is too heavy, as the result of excessive internal friction within the lubricant itself. With certain types of grease, abnormal increase in temperature may cause sufficient decrease in body to result in separation of the oil from the soap, thereby causing marked reduction in lubricating value, and loss of oil by leakage if the bearing is not oil-sealed. In the variable speed transmission, this might also result in oil to drip or be thrown on to the V-belt impairing the fabric and reducing the traction effect on the pulleys.

Operators should be carefully educated to the lubricating requirements of ball and roller bearings, just as the management should be impressed with the folly of purchasing unsuitable products, regardless of cost per pound or gallon. The conclusion may often be drawn that increase in temperature is due to lack of lubrication. On the other hand, where a bearing runs warm due to too heavy a grease, addition of more grease will only aggravate conditions. There will also be the danger of forcing some grease past the seals. Bearings of this type have but a limited capacity for grease, which should never be exceeded, and this grease should be of the highest quality.

There is no direct method by which application of grease to anti-friction bearings can be absolutely



Courtesy of Chicago Pneumatic Tool Company

Figure 15 — Showing the use of an angle head model impact wrench, and how it enables the operator to reach inacessible nuts and bolts on a truck frame.

controlled. Certain types of bearings, however, can be vented to reduce the possibility of imposing the full pressure of the lubricating equipment upon the seals; these latter must of course be maintained in suitable condition with respect to the housing if they are to positively prevent leakage of lubricant under continuous operation.

Type of Grease

A grease for ball or roller bearing lubrication must be practically free from acid-forming tendencies if positive protection of the highly polished metallic surfaces is to be maintained. This means a virtually neutral product is required which contains no fillers. The grease must also show minimum tendency towards oxidation, decomposition, separation and development of free acidity, otherwise corrosion or pitting of the surfaces of the rolling elements may result.

For bearing lubrication in electric motor or variable speed transmission service, a grease compounded from a medium viscosity, highly refined, straight mineral oil and a soap which is suitable for comparatively high temperature service will give lowest starting and operating torque and best assurance against separation, oxidation and gum formation.

OVERHEAD HOISTS

At various stages in the assembly line certain parts must be handled vertically or horizontally by the same unit. The overhead air-motor hoist is a key machine in this operation. It is used for turning over truck frames, for lowering the motors into the trucks, and for handling various other heavy parts horizontally or vertically which otherwise would have to be handled manually.

At these key points on the assembly line it is absolutely essential that the hoists function dependably. Failure of one of these hoists due to faulty lubrication could easily disrupt a production schedule because the assembly line would have to be stopped while replacement or repair could be made. In effect, a hoist is like a parachute, it either must function when called upon, or trouble occurs.

The overhead hoist travels on a horizontal trolley. To realize its infinite throttle control one must see an operator lower a truck Diesel engine into place on the frame as the latter is moving slowly along the assembly line. In other words with scarcely a touch on the control handles an experienced operator can locate parts with respect to one another where clearances may be but a slight fraction of an inch.

Design Related to Lubrication

In view of the vital importance of these hoists they must be properly maintained and effectively lubricated. The reciprocating type of air motor is well suited to the service involved. Four cylinder radial construction is widely used. The entire mechanism is well housed in a dust and dirt-proof case. This type of housing serves another purpose, since it prevents oil dripping on to the truck frame or other parts being handled, and thereby avoids the possibility of hazard to personnel, or oil spots which might interfere with subsequent painting.

The air-motor is lubricated by splash and force feed as shown in Figure 16. A very high quality petroleum lubricating oil inhibited against rust and oxidation having a viscosity around 300 seconds Saybolt Universal at 100° F. is usually satisfactory under the temperature conditions prevailing in the average assembly line building.

PNEUMATIC TOOLS

Fittings are attached to a truck frame mostly by bolts and nuts, or perhaps by riveting. This requires the use of air-driven wrenches or riveters. Wrenches are usually of the rotary type, riveters are of percussive type.

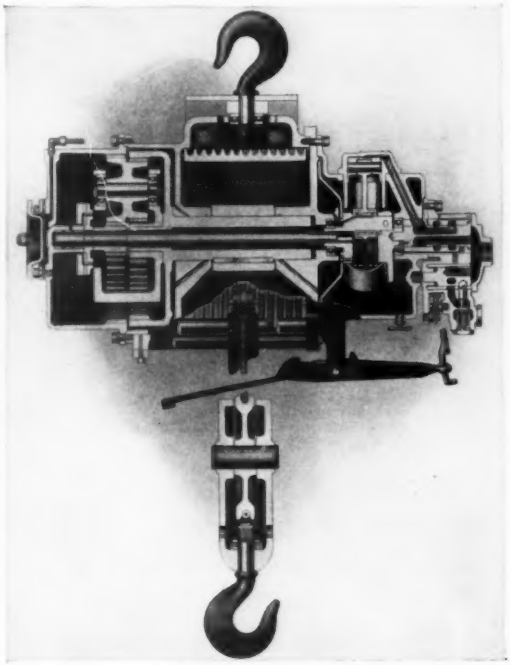
The rotary type of wrench involves an air-driven rotor fitted with suitable vanes. This rotor drives the working part of the tool, either through direct drive or suitable reduction gearing. The rotary vane air motor is very versatile. In addition to powering as a wrench to run nuts on or off bolts it can be used on the automotive assembly line to drive a screwdriver, or, it can be built to drill, ream, countersink or tap.

The structural advantages involve ball bearings, built-in lubrication and ready interchange of attachments.

Lubrication requirements involve an oil and a grease. The vanes and cylinders usually can be operated on the same type of oil as used for the overhead hoist. In some designs the oil supply is carried in reservoirs in the tool and delivered to the air stream through a felt feeder. In others a line oiler or a combination of both may be provided.

In view of the use of ball bearings and gearing, the rotary vane air tool is usually designed for grease lubrication of these parts, using a high quality N.L.G.I. No. 2 grade of anti-friction bearing grease of lithium soap or mixed base (lime-soda). If such a grease is inhibited against oxidation, there is added insurance against gumming of the lubricant and sluggish action of the tool.

Considerable churning occurs when the gears in any such tool are operating. This means that fresh surfaces of grease are continually exposed to the oxidizing effect of air. Fortunately there is not too much danger of overheating in running assembly line tools as operation is "on" and "off" most of the time. While running, however, this churning can act as an accelerant to oxidation of the grease.



Courtesy of Ingersoll-Rand

Figure 16 — Details of the I-R air motor hoist. This is one of the most widely used tools on the entire assembly line to facilitate manipulation of heavy parts.

Care and Handling

The means by which lubricants are applied or distributed has a marked effect upon the operation of air tools. Even the best of oils or greases may fail to do their work if they are carelessly used, or in such a manner as to be unable to reach all the wearing elements of the tools. More failures or complaints arise from insufficient or no lubrication than from any average operating condition. In many cases, this is due to ignorance; or neglect usually because operators do not appreciate the necessity for lubricating their equipment.

Air Line Oilers

Air line oilers work on the principle of atomization. The air in its passage through the oiler draws the requisite amount of oil from the reservoir by suction. This method of feeding insures effective distribution to all parts of the tool with which it comes in contact. The capacity of the lubricator depends upon the volume of air required by the tool.

Courtesy of The White Motor Company

Figure 17 — Section of a cab assembly line.

Dust and Dirt are Abrasive

Careless handling in the presence of dust and dirt which may enter the tool along with the dirt which may be carried through the tool by the air itself will be always a potential cause of wear. Normally it is easy to prevent abrasive foreign matter from entering the tool itself via the air line if an air filter is installed and if the hose is in good condition. Care in handling when not in actual operation will prevent dirt entering from other sources. If the tool is stored in an oil bath or rested in a position or locality reasonably free from dirt when not in use it should function satisfactorily for an indefinite period.

Clean Air Necessary

Clean air should always be used in air tools. The location of the compressor, its air intake, whether or not air filters are installed, and the cleanliness of the inter-coolers, pipe lines and air hose all can affect air quality. Furthermore, if any of the parts are rusted on the interior surfaces, particles of rust may flake off and be carried along by the air.

To keep out particles of rubber from the air hose and gaskets which would interfere with the free operation of the tool mechanisms, some authorities recommend locating a strainer in the inlet pipe. Others include a strainer in the tool itself. Strainers should effectively remove the greater part of any solid foreign matter and protect the working mechanisms of the tool. The strainer must be cleaned at frequent and regular intervals.

Automatic lubrication by means of air line oilers or atomizers mechanically delivers the requisite amount of clean oil to the air lines. Lubricators of this type prevent contamination of the oil from exterior sources if the fresh oil is kept clean. Any oil containers used on the job must be of the closed-cover type to assure of this.

In the absence of automatic means of lubrication, air tools must be periodically oiled by hand. There is more possibility of accidental entry of dust or dirt occurring under such conditions.

At best operators' hands will be dirty. The lubricants should be stored and handled with even greater care. They should be kept in closed containers where they will be handy and eliminate loss of time when lubricating.

CONCLUSION

Glamour can be associated with more than pulchritude; it definitely applies to the assembly line where the dreams of the designers take form and become the latest model motor vehicles. To make these dreams materialize demands machinery which will function in perfect synchronization with its neighboring machine. Lubrication of the essential operating parts of this machinery must be effective and dependable if the production schedule is to be maintained. A conveyor motor or air-hoist out of service due to bearing trouble can upset the best laid production plans.

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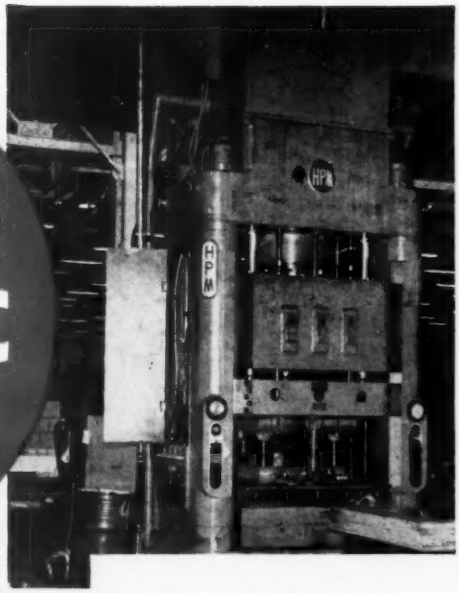

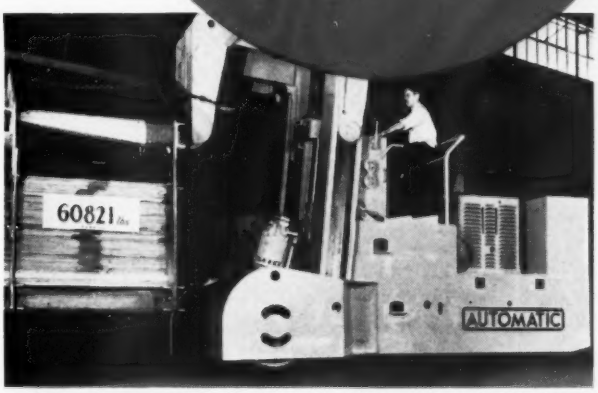

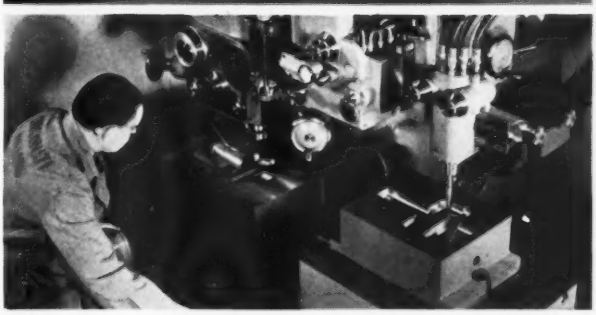

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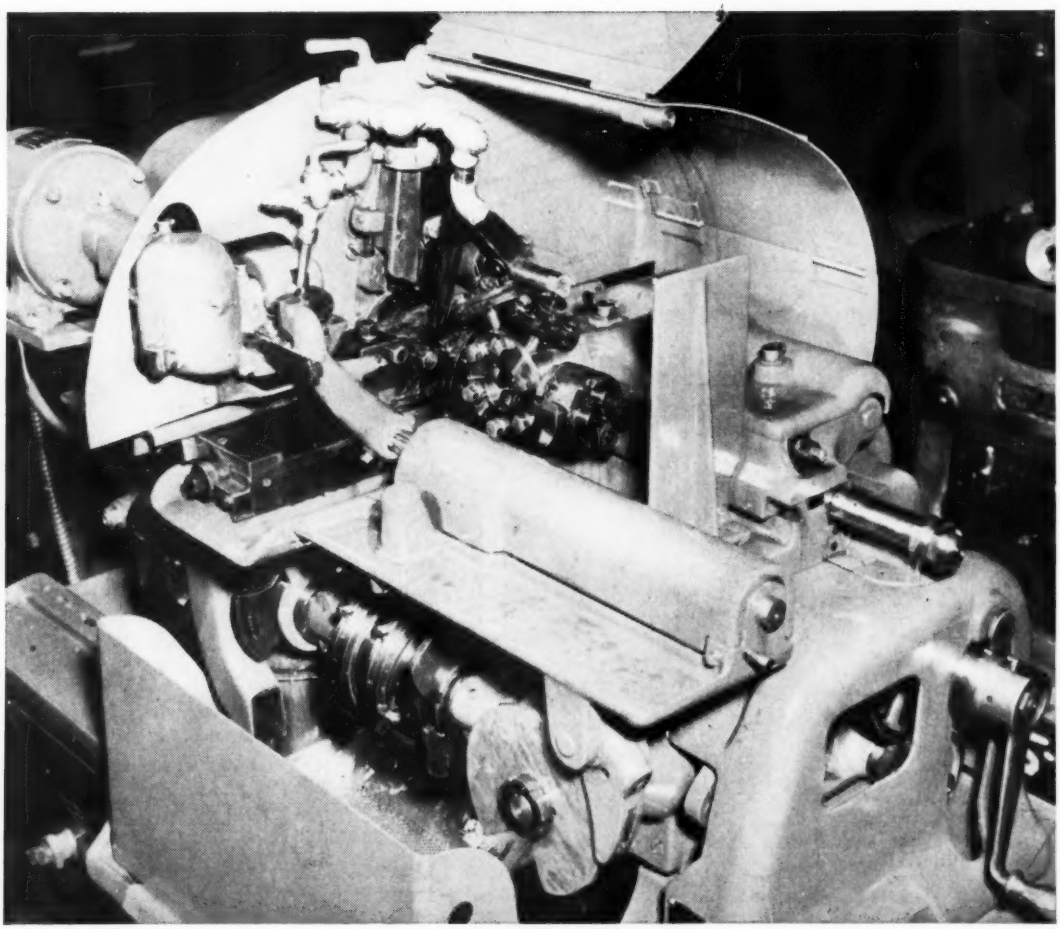

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